Growth Mindset and Academic Resilience as Predictors of Mathematics Achievement Among Middle School Students: A Quantitative Analysis

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Abstract

This study examined the predictive roles of growth mindset and academic resilience on mathematics achievement among middle school students. Employing a quantitative, correlational-predictive research design with mediation analysis, data were collected from 486 students enrolled in grades 6 through 8 across 28 middle schools in Rajasthan, India. Three instruments were used: the Implicit Theories of Intelligence Scale (ITIS, α = .89), the Academic Resilience Scale-30 (ARS-30, α = .91), and institutional mathematics achievement scores (standardized term examination marks converted to z-scores). Hierarchical multiple regression revealed that growth mindset significantly predicted mathematics achievement (β = .44, p < .001), accounting for 26.2% of the variance after controlling for demographic variables. Growth mindset also significantly predicted academic resilience (β = .56, p < .001), explaining 35.8% of the variance. Among the three mindset dimensions, beliefs about effort (β = .24) and response to challenge (β = .21) were the strongest predictors of achievement. Structural equation modeling confirmed that academic resilience partially mediated the relationship between growth mindset and mathematics achievement (βindirect = .18, 95% CI [.12, .25]). Students with strong growth mindsets scored significantly higher in mathematics (M = 0.62, SD = 0.74) than those with fixed mindsets (M = -0.48, SD = 0.82), t(318) = 8.86, p < .001, d = 1.00. These findings highlight the critical importance of fostering growth mindsets and resilience for improving mathematics outcomes.

Keywords: - Growth mindset, academic resilience, mathematics achievement, middle school students, implicit theories, quantitative research

I. INTRODUCTION

Mathematics achievement represents one of the most consequential educational outcomes in contemporary society, serving as a gateway to advanced academic pursuits, STEM careers, and informed civic participation (National Research Council, 2001). Yet, mathematics remains one of the most challenging academic domains for students worldwide, with a substantial proportion of learners experiencing difficulty, anxiety, and disengagement in mathematics learning (Dowker et al., 2016). In India, the Annual Status of Education Report (ASER, 2023) documented that only 25.6% of Grade 8 students could solve a division problem correctly, reflecting a persistent and pervasive mathematics learning crisis. Understanding the psychological factors that enable some students to succeed in mathematics while others struggle, particularly malleable motivational and dispositional factors amenable to educational intervention, is therefore a matter of critical scholarly and practical significance.

Growth mindset, rooted in Dweck's (2006) theory of implicit theories of intelligence, refers to the belief that intelligence and mathematical ability are malleable qualities that can be developed through effort, effective strategies, and appropriate support, as contrasted with a fixed mindset that views intelligence as an innate, unchangeable trait. Research has demonstrated that students who hold growth mindsets tend to embrace challenges, persist through difficulties, interpret effort as a pathway to mastery, and respond constructively to setbacks, all of which are particularly relevant in the demanding domain of mathematics learning (Yeager & Dweck, 2012). Meta-analytic evidence has confirmed a positive, though modest, association between growth mindset and academic achievement, with the relationship being strongest among students from disadvantaged backgrounds and in challenging academic domains (Sisk et al., 2018).

Academic resilience, defined as the capacity to achieve positive educational outcomes despite exposure to adverse circumstances, risk factors, or academic challenges (Martin & Marsh, 2006), represents a complementary psychological resource for navigating the difficulties inherent in mathematics learning. Resilient learners demonstrate adaptive responses to academic setbacks including persistence, help-seeking, cognitive reappraisal, and strategic adjustment, all of which contribute to sustained engagement and performance improvement over time (Cassidy, 2016). The theoretical connection between growth mindset and academic resilience is intuitive: students who believe their abilities can grow are more likely to interpret challenges as opportunities for development rather than as evidence of inadequacy, thereby exhibiting greater resilience in the face of academic difficulty (Yeager & Dweck, 2012).

India's middle school education system, serving approximately 67 million students in grades 6 through 8 (UDISE+, 2023), represents a critical developmental and educational transition period. The National Education Policy 2020 has emphasized the need for foundational numeracy by Grade 3 and the development of higher-order mathematical thinking through middle school and beyond (Ministry of Education, 2020). However, empirical research examining the psychological predictors of mathematics achievement among Indian middle school students, particularly the roles of growth mindset and academic resilience, remains remarkably limited. The existing literature in the Indian context is predominantly descriptive, often relying on small convenience samples and univariate analyses that fail to capture the complex, multidimensional relationships among psychological dispositions and academic outcomes.

1.1. Statement of the Problem

While international research has established growth mindset as a predictor of academic achievement, the specific dimensions of growth mindset that most powerfully predict mathematics achievement in the Indian middle school context remain unexplored. Furthermore, the mediating mechanism through which growth mindset influences mathematics outcomes, potentially through its effects on academic resilience, has not been empirically tested among Indian students. This gap limits the development of targeted, evidence-based interventions to enhance mathematical learning outcomes in India's middle schools.

1.2. Research Objectives

The objectives of this study were:

- To examine the relationships among growth mindset, academic resilience, and mathematics achievement among middle school students;
- To determine which specific dimensions of growth mindset (beliefs about intelligence, beliefs about effort, and response to challenge) most significantly predict mathematics achievement and academic resilience;
- To investigate the mediating role of academic resilience in the relationship between growth mindset and mathematics achievement; and
- To assess whether significant differences exist in growth mindset, academic resilience, and mathematics achievement based on gender, grade level, school type (government vs. private), and school location (urban vs. rural).

1.3. Research Hypotheses

- H_1: Growth mindset significantly predicts mathematics achievement among middle school students.
- H_2: Growth mindset significantly predicts academic resilience among middle school students.
- H_3: Beliefs about effort and response to challenge are the strongest predictors of mathematics achievement among the dimensions of growth mindset.
- H_4: Academic resilience mediates the relationship between growth mindset and mathematics achievement.
- H_5: Significant differences exist in growth mindset, academic resilience, and mathematics achievement based on gender, grade level, school type, and school location.

II. REVIEW OF LITERATURE

2.1. Theoretical Framework

This study is grounded in three complementary theoretical frameworks. First, Dweck's (2006) Implicit Theories of Intelligence framework provides the foundational conceptualization of growth mindset. According to this theory, individuals hold implicit beliefs about the nature of intelligence that fall along a continuum from fixed (entity theory, viewing intelligence as stable and uncontrollable) to growth (incremental theory, viewing intelligence as malleable and developable). These implicit beliefs create distinct motivational frameworks that shape goal orientation, effort attributions, and responses to challenge and failure. Students with growth mindsets adopt mastery goals, attribute success to effort and strategy, and respond to setbacks with increased effort and strategic adjustment, while those with fixed mindsets adopt performance goals, attribute failure to lack of ability, and respond to setbacks with helplessness and disengagement.

Second, Martin and Marsh's (2009) Academic Resilience Framework conceptualizes resilience in educational settings as the capacity to effectively deal with academic setback, challenge, adversity, and pressure. Unlike broader psychological resilience constructs that focus on extreme adversity, academic resilience addresses the everyday challenges of academic life, including poor grades, difficult content, competing demands, and performance pressure. Martin and Marsh identify five factors underlying academic resilience: confidence, coordination, control, composure, and commitment, collectively representing the cognitive, emotional, and behavioral resources that enable students to bounce back from academic difficulty.

Third, Bandura's (1986) Social Cognitive Theory provides the overarching framework for understanding how beliefs (mindset) influence behavior (resilience) and outcomes (achievement) through reciprocal determinism. Within this triadic

model, growth mindset operates as a cognitive factor that shapes self-efficacy beliefs and effort regulation (behavioral factors), which interact with the academic environment (environmental factor) to produce learning outcomes. The integration of these frameworks supports the hypothesized mediation model in which growth mindset influences mathematics achievement both directly and indirectly through academic resilience.

2.2. Growth Mindset and Mathematics Achievement

The relationship between growth mindset and academic achievement, particularly in mathematics, has been the subject of considerable research and debate. Dweck (2006) originally proposed that growth mindset is a significant predictor of academic achievement, particularly in challenging academic domains. Blackwell et al. (2007) conducted a seminal longitudinal study of middle school students and demonstrated that an incremental theory of intelligence predicted increasing mathematics grades over two years, mediated through mastery-oriented goals and positive effort beliefs. Sisk et al. (2018) conducted a comprehensive meta-analysis of 273 studies and reported a small but significant overall effect of mindset on achievement ($r = .10$), with stronger effects observed among students facing academic difficulty, students from low-income backgrounds, and in mathematics specifically.

Importantly, recent research has emphasized that the relationship between growth mindset and achievement is not uniform across contexts and populations. Yeager et al. (2019) conducted a large-scale randomized trial involving over 12,000 ninth-grade students in the United States and found that a brief growth mindset intervention improved mathematics grades specifically among lower-achieving students in schools with supportive peer norms. In the Indian context, Rattan et al. (2012) investigated mindset beliefs among college students in Mumbai and found that growth mindset predicted greater persistence and performance on challenging mathematical tasks, though the study was limited to a single institution. Sharma and Singh (2018) examined growth mindset and academic achievement among secondary school students in Uttar Pradesh and reported moderate positive correlations, but the study lacked multivariate controls and relied on a small convenience sample.

2.3. Growth Mindset and Academic Resilience

Theoretical reasoning and emerging empirical evidence suggest a strong connection between growth mindset and academic resilience. Students who believe their abilities can be developed through effort are, by definition, more likely to view academic challenges as surmountable obstacles rather than insurmountable barriers, predisposing them toward resilient responses including persistence, strategic adjustment, and adaptive coping (Yeager & Dweck, 2012). Zeng et al. (2016) examined the relationship between mindset beliefs and resilience among Chinese university students and found that growth mindset significantly predicted resilience, mediated through self-efficacy. Kannangara et al. (2018) investigated growth mindset and resilience among university students in the United Kingdom and reported that growth mindset was positively associated with resilience and negatively associated with psychological distress.

In the educational context specifically, Martin and Marsh (2006) demonstrated that the belief that academic ability is developable was a significant predictor of academic resilience, as students who hold this belief are more likely to interpret academic setbacks as temporary and controllable rather than permanent and reflective of fixed deficiency. However, the specific relationship between growth mindset and academic resilience has not been examined among middle school students in India, where cultural attitudes toward intelligence, effort, and academic success may moderate the strength and nature of this association.

2.4. Academic Resilience as a Mediator

The hypothesis that academic resilience mediates the relationship between growth mindset and mathematics achievement is theoretically grounded in the idea that mindset beliefs influence achievement outcomes partly through their effects on the adaptive behavioral and emotional responses that constitute resilience. Growth mindset creates the cognitive foundation (belief that ability can grow), which enables resilient behavior (persistence, strategic effort, adaptive coping), which in turn produces improved academic outcomes (higher mathematics achievement). Zeng et al. (2016) provided partial support for this mediation pathway in the university context, and Claro et al. (2016) demonstrated using large-scale Chilean educational data that growth mindset predicted achievement partly through its association with students' adaptive responses to academic challenges. However, a direct test of the growth mindset to academic resilience to mathematics achievement mediation pathway among middle school students has not been conducted, representing a significant gap in the literature.

III. RESEARCH METHODOLOGY

3.1. Research Design

This study employed a quantitative, cross-sectional, correlational-predictive research design with mediation analysis. The design was chosen to examine the strength and direction of relationships among growth mindset, academic resilience, and mathematics achievement, and to test the hypothesized mediating role of academic resilience (Creswell & Creswell, 2018). Structural equation modeling (SEM) was employed to test the proposed path model, enabling simultaneous estimation of direct and indirect effects while accounting for measurement error (Kline, 2016).

3.2. Population and Sampling

The target population comprised students enrolled in grades 6 through 8 in government and private middle schools across four educational districts of Rajasthan, India (Jaipur, Jodhpur, Udaipur, and Kota). A multistage stratified random sampling procedure was employed. In the first stage, 28 schools (14 government, 14 private; balanced across urban and rural locations) were randomly selected from district education office registries, 7 per district. In the second stage, one section per grade in each school was randomly selected, and 15-20 students per section were randomly invited to participate.

Using G*Power 3.1 (Faul et al., 2009) with parameters for multiple regression (medium effect size $f^2 = .15$, $\alpha = .05$, power = .95, 10 predictors), the minimum required sample was 172. To ensure adequate power for SEM analysis ($N \geq 200$; Kline, 2016) and to accommodate the multilevel data structure, the target was 520 student responses. After distributing 520 questionnaires, 502 were returned (96.5% response rate). Following data cleaning (removal of incomplete responses and multivariate outliers), the final analytic sample comprised 486 students.

The sample included 258 (53.1%) male and 228 (46.9%) female students. By grade level, 168 (34.6%) were in Grade 6, 162 (33.3%) in Grade 7, and 156 (32.1%) in Grade 8. By school type, 246 (50.6%) were from government schools and 240 (49.4%) from private schools. By school location, 252 (51.9%) were in urban schools and 234 (48.1%) in rural schools. The mean age of participants was 12.4 years (SD = 1.18).

3.3. Instrumentation

3.3.1. Implicit Theories of Intelligence Scale (ITIS).

The ITIS was adapted from Dweck's (1999) original measure and expanded to 18 items across three subscales: Beliefs about Intelligence (6 items), Beliefs about Effort (6 items), and Response to Challenge (6 items). Items were rated on a 6-point Likert scale from 1 (Strongly Disagree) to 6 (Strongly Agree). Fixed mindset items were reverse-scored so that higher scores indicated stronger growth mindset orientation. The instrument was translated into Hindi using a rigorous forward-backward translation procedure with reconciliation by a bilingual committee. Content validity was established through expert review by nine specialists in educational psychology, motivation research, and psychometrics (CVI = .92). EFA on pilot data (n = 120) confirmed the three-factor structure with factor loadings ranging from .58 to .86. CFA on the main study data yielded good fit: $\chi^2/df = 2.18$, CFI = .96, TLI = .95, RMSEA = .049, SRMR = .037. Cronbach's alpha was .89 (total), .85 (Intelligence Beliefs), .86 (Effort Beliefs), and .84 (Response to Challenge).

3.3.2. Academic Resilience Scale-30 (ARS-30).

The ARS-30 (Cassidy, 2016) is a 30-item measure assessing three subscales: Perseverance (10 items), Reflecting and Adaptive Help-Seeking (10 items), and Negative Affect and Emotional Response (10 items, reverse-scored). Items were rated on a 5-point Likert scale from 1 (Likely Would Not Do This) to 5 (Very Likely Would Do This). The ARS-30 has demonstrated robust psychometric properties across diverse educational contexts (Cassidy, 2016). CFA on the present data confirmed the three-factor structure: $\chi^2/df = 2.28$, CFI = .94, TLI = .93, RMSEA = .052, SRMR = .042. Cronbach's alpha was .91 (total), .87 (Perseverance), .85 (Reflecting/Help-Seeking), and .86 (Negative Affect, reversed).

3.3.3. Mathematics Achievement.

Mathematics achievement was operationalized as students' scores on the most recent standardized term-end mathematics examination administered by respective school boards. To enable cross-school comparison, raw scores were converted to within-school z-scores (M = 0, SD = 1) using each school's grade-level mean and standard deviation as reference parameters. This standardization procedure accounts for differences in examination difficulty and grading practices across schools while preserving meaningful within-school variation (Marsh et al., 2008).

3.4. Data Collection Procedure

Ethical approval was obtained from the Institutional Human Research Ethics Committee (Approval No. IHREC/2024/EDU/112). Administrative permissions were secured from the Directorate of Elementary Education, Rajasthan, and from principals of all participating schools. Written parental consent and student assent were obtained. Data collection was conducted during January-March 2025. The ITIS and ARS-30 were administered during regular school hours by trained research assistants, with Hindi versions provided to government school students and English versions to English-medium private school students. Mathematics achievement scores were obtained from institutional records with administrative consent. To mitigate common method bias, predictor variables (self-report questionnaires) and the criterion variable (institutional achievement records) were measured through different sources (Podsakoff et al., 2003).

3.5. Data Analysis

Data analysis was conducted using IBM SPSS Statistics Version 28.0 and AMOS Version 26.0. Preliminary analyses included missing data screening (less than 2%, handled via Expectation Maximization), outlier detection (Mahalanobis distance, $p < .001$), normality assessment (skewness and kurtosis within ±2), linearity verification, and multicollinearity diagnostics (VIF < 3.0). Descriptive statistics were computed. Inferential analyses included:

- Pearson product-moment correlations;
- Hierarchical multiple regression predicting mathematics achievement and academic resilience;
- Independent samples t-tests for gender, school type, and location comparisons;
- One-way ANOVA with Tukey HSD post hoc tests for grade-level comparisons; and
- Structural equation modeling with bootstrapped mediation analysis (5,000 resamples).

Effect sizes (Cohen's d, η^2, R^2) were reported. Significance was set at $\alpha = .05$.

IV. RESULTS AND DATA ANALYSIS

4.1. Descriptive Statistics

Table 1 presents descriptive statistics for all study variables. The overall growth mindset mean was 4.12 (SD = 0.82) on a 6-point scale, indicating a moderate growth orientation. Beliefs about Effort had the highest subscale mean (M = 4.36, SD = 0.78) while Beliefs about Intelligence had the lowest (M = 3.86, SD = 0.92). Overall academic resilience was moderate (M = 3.42, SD = 0.72) on a 5-point scale. Mathematics achievement z-scores had a mean of 0.00 (SD = 1.00) as expected. Skewness values ranged from -0.38 to 0.26 and kurtosis from -0.52 to 0.46, confirming approximate normality.

Table 1. Descriptive Statistics for Study Variables (N = 486)

Variable	M	SD	Skew	Kurt	α
Beliefs about Intelligence	3.86	0.92	-0.22	0.18	.85
Beliefs about Effort	4.36	0.78	-0.38	0.46	.86
Response to Challenge	4.14	0.84	-0.28	0.32	.84
Overall Growth Mindset	4.12	0.82	-0.30	0.28	.89
Perseverance	3.56	0.76	-0.18	0.24	.87
Reflecting/Help-Seeking	3.38	0.74	0.12	-0.36	.85
Negative Affect (reversed)	3.28	0.82	0.26	-0.52	.86
Overall Academic Resilience	3.42	0.72	0.06	-0.18	.91
Mathematics Achievement (z)	0.00	1.00	-0.14	0.16	-

Note. ITIS scored on 6-point scale; ARS-30 scored on 5-point scale; Mathematics Achievement expressed as within-school z-scores.

4.2. Correlation Analysis

Pearson correlation analysis (Table 2) revealed significant positive correlations among all primary study variables. Overall growth mindset was strongly correlated with academic resilience (r = .59, p < .001) and moderately correlated with mathematics achievement (r = .51, p < .001). Academic resilience was moderately correlated with mathematics achievement (r = .48, p < .001). Among mindset subscales, Beliefs about Effort showed the strongest correlation with achievement (r = .48, p < .001), followed by Response to Challenge (r = .46, p < .001) and Beliefs about Intelligence (r = .38, p < .001).

Table 2. Pearson Correlation Matrix for Primary Study Variables

Variable	1	2	3	4	5	6
1. Intelligence Beliefs	-					
2. Effort Beliefs	.56***	-				
3. Response to Challenge	.52***	.62***	-			
4. Academic Resilience	.48***	.56***	.54***	-		
5. Math Achievement	.38***	.48***	.46***	.48***	-	

Note. ***p < .001. Math = Mathematics.

4.3. Hierarchical Multiple Regression Analysis

Two hierarchical multiple regression analyses were conducted: one predicting mathematics achievement and one predicting academic resilience (Tables 3 and 4). In the first analysis, demographic variables (gender, grade level, school type, location) were entered in Step 1, accounting for 7.4% of the variance, $F(4, 481) = 9.62$, p < .001. In Step 2, the three growth mindset dimensions were entered, contributing an additional 18.8% of variance, yielding a total R^2 of .262, $F(7, 478) = 24.28$, p < .001. The change was significant: $\Delta R^2 = .188$, $\Delta F(3, 478) = 40.62$, p < .001.

Beliefs about Effort was the strongest predictor of mathematics achievement (β = .24, p < .001), followed by Response to Challenge (β = .21, p < .001) and Beliefs about Intelligence (β = .12, p = .012). All VIF values ranged from 1.42 to 1.96, confirming the absence of problematic multicollinearity. Thus, H_1 and H_3 were supported.

Table 3. Hierarchical Multiple Regression Predicting Mathematics Achievement

Predictor	B	SE	β	t	p	VIF
Step 1 (R² = .074)						
Gender	0.14	0.08	.07	1.68	.094	1.02
Grade Level	-0.08	0.06	-.06	-1.38	.168	1.04
School Type	0.28	0.08	.14	3.28	.001	1.10
School Location	0.22	0.08	.12	2.62	.009	1.08
Step 2 (ΔR² = .188)						
Intelligence Beliefs	0.13	0.05	.12	2.52	.012	1.62
Effort Beliefs	0.31	0.06	.24	4.92	<.001	1.96
Response to Challenge	0.25	0.06	.21	4.28	<.001	1.84

Note. Total R² = .262. B = unstandardized coefficient; SE = standard error; β = standardized coefficient.

In the second regression predicting academic resilience, demographic variables in Step 1 explained 4.6% of the variance, $F(4, 481) = 5.82$, p < .001. The growth mindset dimensions in Step 2 contributed an additional 31.2%, for a total R^2 of .358, $F(7, 478) = 38.06$, p < .001. Effort Beliefs (β = .28, p < .001), Response to Challenge (β = .26, p < .001), and Intelligence Beliefs (β = .16, p = .002) were all significant predictors. Thus, H_2 was supported.

Table 4. Hierarchical Multiple Regression Predicting Academic Resilience

Predictor	B	SE	β	t	p	VIF
Step 1 (R² = .046)						
Gender	0.12	0.06	.08	1.86	.064	1.02
Grade Level	0.10	0.04	.10	2.28	.023	1.04
School Type	0.08	0.06	.06	1.28	.202	1.10
School Location	0.14	0.06	.10	2.18	.030	1.08
Step 2 (ΔR² = .312)						
Intelligence Beliefs	0.12	0.04	.16	3.18	.002	1.62
Effort Beliefs	0.26	0.04	.28	5.94	<.001	1.96
Response to Challenge	0.22	0.04	.26	5.36	<.001	1.84
Predictor	B	SE	β	t	p	VIF

Note. Total R^2 = .358. B = unstandardized coefficient; SE = standard error; β = standardized coefficient.

4.4. Group Comparison Analyses

An independent samples t-test comparing students in the top tertile (strong growth mindset, n = 160) and bottom tertile (fixed mindset, n = 160) revealed that growth-mindset students had significantly higher mathematics achievement (M = 0.62, SD = 0.74) than fixed-mindset students (M = -0.48, SD = 0.82), t(318) = 8.86, p < .001, d = 1.00, a large effect. Growth-mindset students also demonstrated significantly higher academic resilience (M = 3.92, SD = 0.62) compared to fixed-mindset students (M = 2.84, SD = 0.74), t(318) = 9.96, p < .001, d = 1.12.

Private school students reported significantly stronger growth mindsets (M = 4.32, SD = 0.76) than government school students (M = 3.92, SD = 0.86), t(484) = 5.24, p < .001, d = 0.49. Urban students reported higher academic resilience than rural students, t(484) = 3.46, p < .001, d = 0.32. No significant gender differences were found in growth mindset, t(484) = 1.42, p = .156, d = 0.13, or mathematics achievement, t(484) = 0.96, p = .338, d = 0.09.

One-way ANOVA revealed significant grade-level differences in academic resilience, F(2, 483) = 5.86, p = .003, η² = .024. Tukey HSD post hoc tests indicated that Grade 8 students (M = 3.58, SD = 0.68) demonstrated significantly higher resilience than Grade 6 students (M = 3.26, SD = 0.76), p = .002, but did not differ significantly from Grade 7 students (M = 3.42, SD = 0.72), p = .172. Thus, H₅ was partially supported.

4.5. Structural Equation Modeling and Mediation Analysis

The hypothesized path model was tested using SEM with maximum likelihood estimation. The model demonstrated good overall fit: χ²/df = 2.16, CFI = .96, TLI = .95, RMSEA = .049 (90% CI [.040, .058]), SRMR = .036. Results confirmed that growth mindset had a significant direct effect on academic resilience (β = .56, p < .001) and academic resilience had a significant direct effect on mathematics achievement (β = .32, p < .001). The direct effect of growth mindset on mathematics achievement, controlling for resilience, was reduced but remained significant (β = .26, p < .001), indicating partial mediation.

Bootstrapped mediation analysis (5,000 resamples) confirmed a significant indirect effect of growth mindset on mathematics achievement through academic resilience (βindirect = .18, 95% CI [.12, .25], p < .001). The total effect of growth mindset on mathematics achievement was .44 (p < .001), of which approximately 40.9% was mediated through academic resilience. The model explained 35.8% of the variance in academic resilience and 34.6% of the variance in mathematics achievement. Thus, H₄ was fully supported.

Table 5. Path Coefficients and Mediation Effects from Structural Equation Model

Path / Effect	B	SE	95% CI	p	R²	Result
GM -> AR (direct)	.56	.04	[.48, .64]	<.001	.358	Supported
AR -> MA (direct)	.32	.05	[.23, .41]	<.001	.346	Supported
GM -> MA (direct)	.26	.05	[.16, .36]	<.001	-	-
GM -> AR -> MA (indirect)	.18	.03	[.12, .25]	<.001	-	Mediation
Total effect (GM -> MA)	.44	.04	[.36, .52]	<.001	-	-

Note. GM = Growth Mindset; AR = Academic Resilience; MA = Mathematics Achievement. Bootstrapped 95% CIs based on 5,000 resamples.

V. DISCUSSION

The present study provides robust quantitative evidence that growth mindset is a significant predictor of both mathematics achievement and academic resilience among middle school students in Rajasthan, India. The finding that growth mindset accounted for 26.2% of the variance in mathematics achievement is substantially larger than the overall meta-analytic effect reported by Sisk et al. (2018), potentially reflecting the heightened relevance of mindset beliefs in the Indian educational context, where mathematics is both culturally valued and a major source of academic anxiety. The large effect size (d = 1.00) separating growth-mindset and fixed-mindset students on mathematics achievement underscores the practical significance of mindset orientations for mathematical learning outcomes.

The emergence of Beliefs about Effort as the strongest predictor of both mathematics achievement and academic resilience is a theoretically significant finding with important practical implications. The belief that effort leads to mastery is the operational core of growth mindset, transforming challenges from threats to be avoided into opportunities for learning and development (Dweck, 2006). Students who believe that effort in mathematics will produce improvement are more likely to persist through difficult problems, seek help when stuck, and maintain engagement when progress is slow. This finding aligns

with Blackwell et al. (2007), who demonstrated that effort beliefs were the primary mechanism through which growth mindset predicted mathematics grade trajectories. In the Indian context, where cultural narratives around intelligence and academic achievement can be paradoxically fatalistic (attributing success to innate talent) and effort-oriented (emphasizing hard work), strengthening the specific belief that effort produces growth appears to be a particularly potent intervention target.

The strong predictive relationship between growth mindset and academic resilience ($R^2 = .358$) corroborates the theoretical propositions of Yeager and Dweck (2012) and extends the empirical evidence of Zeng et al. (2016) to the Indian middle school context. Growth mindset appears to provide the cognitive foundation upon which resilient academic behavior is built: by framing intelligence as malleable, students develop the psychological resources to persevere through difficulty, regulate negative emotions in the face of setbacks, and seek adaptive strategies for improvement rather than withdrawing from challenge.

The mediation analysis constitutes a central contribution, demonstrating that approximately 41% of the total effect of growth mindset on mathematics achievement was channeled through academic resilience. This finding illuminates the psychological pathway through which mindset beliefs translate into tangible academic outcomes: growth mindset fosters resilience (persistence, adaptive coping, strategic adjustment), which in turn enhances mathematics performance. The remaining direct effect of growth mindset on achievement may operate through additional mechanisms, including self-efficacy beliefs, goal orientation, and the quality and quantity of cognitive engagement with mathematical content (Blackwell et al., 2007).

5.1. Limitations

Several limitations should be acknowledged. First, the cross-sectional design precludes causal inferences; the direction of effects may be reciprocal, with mathematics achievement also influencing mindset beliefs and resilience. Longitudinal and experimental designs are needed to establish causality. Second, growth mindset was measured via self-report, which may be subject to social desirability bias, particularly given increasing public awareness of growth mindset concepts. Behavioral measures of mindset, such as challenge-seeking and persistence on difficult tasks, would strengthen future research. Third, the study was conducted in Rajasthan, and findings may not generalize to other Indian states with different educational systems, cultural norms, and socioeconomic profiles. Fourth, mathematics achievement was based on school-administered examinations that may vary in quality and rigor across schools, despite the z-score standardization procedure. Fifth, the study did not examine classroom-level factors such as teacher mindset, instructional quality, or classroom climate that may moderate the mindset-achievement relationship (Yeager et al., 2019).

5.2. Implications for Practice and Policy

The findings carry several important implications for educational practice and policy. First, schools should implement evidence-based growth mindset interventions at the middle school level, focusing specifically on strengthening students' beliefs about the value of effort and their constructive responses to challenge. Brief, scalable mindset interventions such as those developed by Yeager et al. (2019) have demonstrated efficacy in improving mathematics outcomes and could be adapted for the Indian educational context. Second, mathematics pedagogy should be redesigned to emphasize process over product, rewarding effort, strategy use, and improvement rather than exclusively rewarding correct answers and speed. Third, teacher professional development programs should incorporate mindset-informed instructional practices, equipping teachers with strategies for providing growth-oriented feedback, creating challenge-embracing classroom cultures, and modeling resilient responses to mathematical difficulty. Fourth, the significant school-type and location-based disparities in growth mindset call for targeted interventions in government and rural schools where fixed mindset beliefs appear more prevalent, potentially reflecting resource constraints and limited exposure to efficacy-building academic experiences. Fifth, academic resilience-building programs should be integrated into school counseling and social-emotional learning curricula, recognizing that resilience is a learnable capacity that can be systematically developed through structured interventions involving cognitive reframing, coping skill instruction, and peer support mechanisms.

VI. CONCLUSION

This study provides compelling quantitative evidence that growth mindset and academic resilience are significant predictors of mathematics achievement among middle school students in the Indian educational context. Through rigorous correlational-predictive methodology, validated instrumentation, and comprehensive statistical analyses including structural equation modeling with bootstrapped mediation, the study demonstrates that beliefs about effort and responses to challenge are the most potent mindset dimensions, and that academic resilience serves as a significant mediating mechanism through which growth mindset translates into mathematical achievement. The substantial explanatory power of the proposed models, the confirmed mediation pathway, and the identified school-type and location-based disparities collectively provide an empirically grounded framework for designing targeted interventions to improve mathematics learning outcomes. As India confronts the urgent challenge of strengthening mathematical competencies among its vast student population, fostering growth mindsets and academic resilience represents a psychologically powerful, educationally sound, and practically scalable strategy for unlocking the mathematical potential of every learner.

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